



Ecosystems-based adaptation: *Are we being conned?* Evidence from Mexico

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ABSTRACT

This paper scrutinises claims made about the promise and efficacy of ecosystems-based adaptation (EBA), through an exploration of EBA-relevant interventions in two fieldsites in Mexico. Our data starts to fill important gaps in current global debates about EBA. We find evidence of the important contribution of interventions relevant to EBA objectives at a small scale and under very specific conditions. However, the viability of similar interventions is substantially reduced, and arguably rendered null, as an incentive for conservation in a more populous fieldsites. Furthermore, evidence suggests that other adaptation options risked being overlooked if the context were viewed solely through the lens of EBA. We conclude that EBA needs to: a) engage with and address the trade-offs which characterised earlier attempts to integrate conservation and development, and; b) acknowledge the implications for its objectives of a globally predominant, neoliberal political economy.

1. Introduction

Ecosystems-based adaptation (EBA) has been gaining prominence since the mid-2000s (BirdLife International, 2009; World Bank, 2009; Andrade et al., 2010; Munroe et al., 2012; UNEP, 2012). The most common definition of EBA is “the use of biodiversity and ecosystem services to help people adapt to the adverse effects of climate change” (SCBD, 2009, p. 41). EBA is not focussed purely on “biodiversity for its own sake” (Petersen and Holness, 2011, p. 4). This is partly due to the conceptual influence of social-ecological systems thinking, which is antithetical to the study of ecological or social systems in isolation (Gunderson and Holling, 2002; Olsson et al., 2004; Berkes, 2008; Berkes et al., 2008, 2008; Folke and Gunderson, 2012). But it also reflects the effort by international conservation (and development) actors such as IUCN, the UNEP, TNC, The World Bank and others to ensure that biodiversity conservation is not left out of the broader climate change adaptation agenda. This, to date, has been characterised predominantly by a focus on development.

Many claims have been made for what EBA is able to offer the broader climate change adaptation agenda. A widely-cited example of its benefits is mangrove forests, given their capacity to shield coastal

populations from storm surges (i.e. Alongi, 2008), and their potential contribution to food security, health, sustainable water management and livelihood diversification (Mensah et al., 2012). The ostensible virtues of EBA lead Munang et al. (2013) to conclude that it can achieve not just win–win but in fact ‘quadruple-win’ outcomes for: climate change adaptation and mitigation; socio-economic development; environmental protection and biodiversity conservation; and contributing to sustainable economic development. (2013: 68). Others make similar claims to synergy in outcomes (i.e. Bood, 2012; Martínez Alonso, 2010; UNEP, 2012). This framing, like ‘sustainable development’ before it, holds intuitive appeal, some of it derived from the substantial economic value posited for ecosystem services. At the global level, it has been estimated that an annual investment of US\$45 billion in protecting ecosystems could yield US\$5 trillion per year (TEEB, 2010). Costanza et al. (2014) estimated that the total global value of ecosystem services – which they define as the monetised contribution of ecosystem services to sustainable human well-being – had in 2011 reached \$125–45 trillion/yr. It follows from this that one mechanism for leveraging this value could be payments for ecosystem services.

Whilst ecosystems-based adaptation clearly has some enthusiastic and influential advocates, the evidence base around its efficacy in

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practice remains a work in progress; partly because the ambiguities in the term's meaning make it difficult to determine what constitutes relevant evidence (Reid, 2011, 2014). A recent systematic review by Doswald et al. (2014) provides the most comprehensive global overview of EBA to date. At the heart of the paper lies a helpful conceptual distinction between EBA and EBA-relevant intervention. The former specifies interventions explicitly conceived and framed in terms of EBA objectives. The latter identifies a broader range of interventions with the potential to achieve EBA objectives, but not designed or implemented with the stated aim of achieving EBA. Doswald et al. draw this distinction because whilst there is as yet little published work on the results of intervention designed explicitly as ecosystems-based adaptation, there are many existing ways of using ecosystems which could serve adaptation purposes, such as sustainable forest management, integrated coastal zone management. Indeed, the mangrove restoration mentioned above as the best known example of EBA turns out in fact to be EBA-relevant, rather than a 'pure' instance of EBA. The payments for ecosystems services schemes we explore in this paper are likewise more accurately termed EBA-relevant. There is a wider point here about what can be said to constitute an example of EBA. Just like sustainable development, EBA is a concept which expresses an objective, a desirable outcome. As such the only way to study EBA empirically is via the interventions that are explicitly used, or could be used, to serve its objectives. At the level of empirical research, the distinction Doswald et al. (2014) formulate between 'pure' and 'EBA-relevant' is thereby collapsed. It is, though, still useful to retain this distinction for the purposes of conceptual debate about what EBA should comprise and aim to achieve.

Overall, Doswald et al. reach mixed conclusions. Whilst they find some evidence to suggest that EBA-relevant interventions "can be effective in enabling the reduction of vulnerability to certain climate induced impacts" they also contend that "it is difficult to provide any conclusions as to the effectiveness [of EBA] over the long term in a changing climate" (2014: 199). Of particular concern, they report that there is more coverage of hypothetical benefits than empirical evidence of benefits. This evaluation, then, is not exactly a glowing recommendation to match the soaring rhetoric which, at least in some quarters, heralded the arrival of EBA. Yet nor, in our view, is it sufficient to declare the term an oxymoron, as sustainable development was famously branded (cf. Redclift, 2005). The critique of sustainable development (or adaptation; cf. Brown, 2011) as oxymoronic perhaps fails sufficiently to recognise that it is not inherently so: it depends upon what is declared to be sustainable development. This proviso leaves plenty of space for conceptualisations of sustainable development which are not oxymoronic. It is hard to see that implying sustainable development per se is an oxymoron helps us to maintain this vital space. By the same token, it would be unfair to frame EBA from the outset in terms of whether it is oxymoronic; it is not so, in our view, in any *a priori* sense. Nevertheless, the mismatch between such optimistic framings and the more ambivalent empirical experiences documented may lead us to wonder, as John Potter (1997) did of sustainable development, *are we being conned?*

We explore this question through presenting a climate vulnerability analysis of people living in or adjacent to protected areas in the Mexican state of San Luis Potosí. The research was commissioned by Mexico's National Commission for Protected Natural Areas (CONANP). Ultimately, their objective was to improve their capacity to respond to the challenges posed by climate change to Mexican protected areas. Project objectives were framed explicitly in terms of identifying ecosystems-based adaptation options, to be implemented in the existing and nascent protected areas which comprise a new biological corridor across the Sierra Madre Oriental region. The work is thus well placed to make a contribution to filling important gaps in the evidence base and to formulating a more grounded set of expectations around the prospects, locally and globally, for EBA. The research addresses two important gaps.

First, the empirical fieldwork comprised a participatory vulnerability analysis, grounded conceptually in a political ecology framework (Blaikie et al., 2004; Cannon and Schipper, 2014). This approach is under-represented in the literature on EBA to date. In the context of our fieldwork, a political ecology lens serves as a corrective to the tendency of EBA studies to over-report hypothetical benefits. A political ecology approach suggests that EBA outcomes will be better understood not as win-wins but as trade-offs, and we outline the trade-offs visible in our fieldsites. We agree with Doswald et al. (2014) and other EBA commentators (i.e. Pramova et al., 2012; van de Sand et al., 2014; Brink et al., 2016) that the conceptualisation of EBA so far gives insufficient attention to trade-offs (with some honourable exceptions, such as Andrade et al., 2010 or Reid, 2014). We find this surprising, given the rich literature, and substantial body of experience accompanying it which concluded, more often than not, that integrated conservation and development lead more frequently to unpalatable trade-offs than to win-win synergy (Adams and McShane, 1992; Brandon and Wells, 1992; Murombedzi, 1992; Murphree, 1997; Neumann, 1997; Newmark and Hough, 2000; Adams et al., 2001, 2004; Hulme and Murphree, 2001; Brockington, 2002; Brown, 2004; McShane and Wells, 2004; McShane et al., 2011). In addition to foregrounding trade-offs, political ecology turns our focus to the winners and losers that result from the power relations governing resource allocation and access (Forsyth, 2003; Blaikie et al., 2004; Robbins, 2012). These considerations are also relevant to broader adaptation debates beyond EBA. As Eriksen et al. (2015) argue, much climate change vulnerability research continues to foreground analyses of climate hazards, to the detriment of a thoroughgoing engagement with the socio-political determinants of vulnerability.

Second, the prospects for using payments for ecosystem services (PES) as a means of delivery of EBA are sparsely covered in the literature, although recent examples have been offered by van de Sand et al. (2014). Wertz-Kanounnikoff et al. (2011), extrapolating from existing instances of PES, have contributed to the conceptualisation of how PES may meet EBA objectives. They argue that PES can be promising instruments for EBA in certain conditions, and identify four potential synergies: natural adaptation co-benefits; piggy-backing; adaptation-relevant spill-overs from PES schemes; and direct payments for adaptation benefits. As we conducted our research on local level vulnerability to climate impacts, it became increasingly clear that Payments for Ecosystem Services schemes, which were being used in both the field sites we discuss in this paper, might already be providing options relevant to EBA, even though they were not being implemented with EBA objectives explicitly in mind. The key potential contribution to adaptation that we identified is: if PES can contribute to ecosystem conservation whilst providing income locally, there would appear to be potential for it to contribute to EBA objectives effectively *to the extent that* it reduces household dependency on climate sensitive livelihood activities. This is probably closest to the 'piggy-backing' synergy – where adaptation benefits are coincidental outcomes – identified by Wertz-Kanounnikoff et al. (2011), at least in the context of our field sites. The prevalence of PES schemes in our fieldsites, in combination with the project objective of identifying EBA options for CONANP, therefore provided a tailor-made opportunity in which to explore this proposition empirically.

In the conclusion, we deliver our verdict on whether EBA is a 'con', and explore the implications of our findings for the future EBA research agenda. Why, we wonder, do the trade-offs we identify persist both within our fieldsites and far beyond them? An underlying reason relates to the existing priorities associated with a globally predominant neo-liberal political economy (Sklair, 2001; Newell, 2008; Brockington et al., 2010; Newsham and Bhagwat, 2016). We contend that what is still missing in the EBA literature is insight into the implications for its objectives of these existing priorities.

Table 1
Key characteristics of fieldsites.

Field site	STATE/ Municipality	Area (ha)	human population	Language	Marginalization index (CONAPO 2011)	Type of ecosystem	Annual precipitation (mm)	Protected Area	PES
La Trinidad	SAN LUIS POTOSÍ/Xilitla	1885	91	Spanish, Nahuatl	−0.76974 (High)	Cloud forest	1300	National forest reserve of San Luis Potosí	yes
Laguna del Mante	SAN LUIS POTOSÍ/Xilitla	45,000	2036	Spanish, Teenek	−0.76835 (High)	Dry forest	965	Abra Tanchipa Biosphere Reserve	yes



Fig. 1. Location of fieldsites in San Luis Potosí state, Mexico.
(Adapted from INEGI, *mapa digital de México*).

2. Theory and methods

2.1. Research context and fieldsites

This research was commissioned as part of an exercise to inform policy-making by CONANP (the National Commission for Protected Natural Areas), and funded by the German development cooperation agency (GIZ). CONANP was formulating its climate change adaptation strategy (CONANP-GIZ, 2013), which set out how CONANP would address the challenges posed by climate change for biodiversity conservation in Mexico's protected areas. Given the particular conservation mission of CONANP, in conjunction with its mandate to help protected area residents deal with climate impacts, ecosystems-based adaptation was an obvious framing concept for operationalising its climate change strategy. It was also the framing concept of choice for GIZ.

As a prior input to formulating the strategy, a 'multi-scalar' vulnerability analysis was conducted in 2011–2013 across the Sierra Madre Oriental (SMO), a mountain range running north-to-south on the eastern side of Mexico (CONANP-GIZ, 2013). The broad objectives of the vulnerability analysis were to establish adaptation priorities, identify EBA measures and document existing instances of adaptive capacity upon which EBA interventions could build.

The vulnerability analysis was conceived as an interdisciplinary,

'multi-scalar' endeavour (CONANP-GIZ, 2013), deploying quantitative and qualitative methods and concepts from agronomy, atmospheric physics, ecology, human geography and hydrology, amongst others. The analysis was organised into 16 discrete components, undertaken by research teams comprised of members of the various institutions commissioned to conduct the analysis. We were allocated the task of designing and conducting the vulnerability analysis at the local level. It sought to understand the climate vulnerability profile of people living within or adjacent to protected areas, and identify appropriate ecosystems-based adaptation measures. The results of the overarching vulnerability analysis are available at CONANP-GIZ (2013).

2.2. Fieldsites

The local vulnerability analysis was conducted in two field sites within the Sierra Madre Oriental: La Trinidad (Newsham et al., 2012a) and Laguna del Mante (Newsham et al., 2012b) (Table 1). The field sites were selected by CONANP because of existing relations and work with communities.

The two fieldsites are *ejidos*, which are lands, forests and waters that the state has granted, in the form of a communal land title, to their inhabitants (*ejidatarios*), to be used in the manner prescribed by the law, under the orientation of the state and community organisation for

Table 2
Methods deployed and numbers of research participants involved.

Participatory method	La Trinidad	Laguna del Mante
Transect walk (rural)	1 walk/2 people	2 walks/2 people per walk
Transect walk (urban)	1 walk/3 people	2 walks/2 people per walk
Mapping	1 group of 14 men; 1 group of 23 women.	1 group of 9 men; 1 group of 5 women.
Historical timeline	First time: 6 men + 2 women; second time: 8 men + 2 women	Approx. 15
Wellbeing ranking	1 group of 22 men; 1 group of 10 women.	1 group of 9 men and 9 women.
Seasonal calendar	1 group of 20 men; 1 group of 22 women.	1 group of 8 men; 1 group of 22 women.
Climate shocks ranking	1 group of 16 men; 1 group of 14 women.	1 group of 8 men; 1 group of 22 women.
Venn diagram	1 group of 22 men; 1 group of 8 women.	1 group of 7 men and 5 women.
Interviews	approx. 8 individual interviews	1 to High School Director; 2 to eco-club; collective interview to 13 high school students; 5 to local people

administration (Appendini, 2008). This type of communal land tenure category was first established by the Mexican Revolution and modified, in the 1990s, in line with neoliberal reforms. These permitted the establishment of private property, through granting *ejidatarios* parcels of land within the *ejido* which could be bought, sold or rented to third parties (Durand-Alcántara, 2009). La Trinidad resembles a conventional, pre-reform *ejido*, in which land has not been split into individual parcels. In Laguna del Mante, privately-held land parcels have been established, even though the *Comisariado*, the standard mechanism for collective *ejido* governance still exists. This difference in the type of land tenure between these two *ejidos* – along with the substantial difference in population size – has fundamental implications for resource access and distribution of PES revenues and related benefits we encountered within them (explored in Sections 3 and 4) (Fig. 1).

General features of fieldsites are summarised in Table 1, while size sample is available in Table 2.

2.2.1. La Trinidad

La Trinidad has 91 inhabitants and is characterised by the Mexican government by a high degree of marginalization (SEDESOL, 2013a).¹ It was originally founded as a settlement in 1967, and whilst its founders requested land title almost immediately thereafter, it did not legally become an *ejido* until 1990. La Trinidad is part of the national forest reserve of San Luis Potosí, and is important for its biodiversity and environmental services such as water infiltration and supply, regulating climate, CO₂ capture and oxygen generation. Approximately 696 ha of its forests are part of a payments for ecosystems services scheme instituted by the National Forestry Commission (CONAFOR), which has been in place since 2003.

Aside from PES activities, farming is a mainstay for many inhabitants, with maize and vegetables most commonly grown. Migration for work in nearby cities, or seasonal agriculture, is also central to livelihood activities. Over time, residents have experimented with a number of livelihood projects with support from NGOs and government agencies. At the time of the research a new eco-tourism project with rural cabins had been launched, representing a potential source of local revenue (Fig. 2).

2.2.2. Laguna del mante

Laguna del Mante emerged as an *ejido* when land known as the Hacienda Pasquel, owned by Mexican industrialist Jorge Pasquel, was redistributed by the Government in 1974. Should Through this program, economically important land was classified as private property, while natural areas – including the Abra Tanchipa Biosphere Reserve – were classified as “*uso común*” (common use). This history has given rise to four relevant local identity categories, all related to land

ownership (or non-ownership): *ejidatarios* (*ejido* members), *hijos de ejidatario* (children of *ejido* members), *avecindados* (rent paying inhabitants living in the vicinity) and *poseionarios* (private land owners). As explored in subsequent sections, the people described by these four categories differ greatly in economic activity, local political rights, and vulnerability to climate impacts.

Census data for Laguna de Mante records a population of 2036 people, most of whom live in conditions of high marginalization (SEDESOL, 2013b). As can be seen in Fig. 3, the boundaries of the *ejido* overlap with the Abra Tanchipa Biosphere Reserve, which was established in 1994. Its surface covers approximately 65% of the Abra Tanchipa Biosphere Reserve. In practice, this means that within the nuclear zone of the Reserve, the greater part of which lies within the *ejido* boundaries, land use and livelihood activities are restricted and governed by national conservation legislation. It also means that Laguna del Mante as an *ejido* is eligible for payments for ecosystem services. The Forestry Commission, CONAFOR, has supported PES incentives, specifically water and biodiversity services, since 2008. While the primary economic activities and urban centre are concentrated in the plains, the adjacent mountains form part of the reserve. One important feature is Presa La Lajilla, an artificial lagoon of approximately 10 km². Drinking water and primary economic activities are dependent on this lagoon. The main economic activities are sugar cane and industrial lemon farming, and shifting cultivation, as well as small-scale cattle farming, fishing and apiculture. Secondary and tertiary activities include the citrus fruit industry and some employment via the Biosphere Reserve.

2.3. Theoretical and methodological framework

The framework we then devised to guide our work on the local level vulnerability analysis is grounded in the ‘Pressure and Release’ (PAR) vulnerability model of Blaikie et al. (2004), which we modified to fit our research purposes more precisely (see Fig. 2 below, and also Cannon and Schipper (2014) for more detail). Whilst PAR is a well-established tool associated with political ecology, it is necessary to spell out, before briefly describing it, what we mean specifically by ‘political ecology’ and how PAR links to the principal concerns of the field – as we see them – at this time. Political ecology is such an eclectic approach that it runs the risk of being caricatured as “all things to all people” (Blaikie, 1999, p. 31). Here is not the place to list the myriad definitions offered (for those, see Forsyth, 2003 or Robbins, 2012). In the context of the intertwined socio-environmental processes which govern responses to climate change (Taylor, 2014; Eriksen et al., 2015), our interest in political ecology is directed toward: a) identifying the winners and losers that result from the power relations governing resource access (Blaikie et al., 2004); b) the implications of discursive power and submerged politics of win-win narratives, which can obscure both the trade-offs which occur and potential alternative courses of action (for those, see Fairhead and Leach, 1998; Forsyth, 2003; Leach et al., 2010; Robbins, 2012). All of these concerns are abundantly manifest in our

¹ Marginalization is the closest translation of the term ‘Marginación’ used by the Mexican government, which is broadly synonymous with the concept of multi-dimensional poverty.

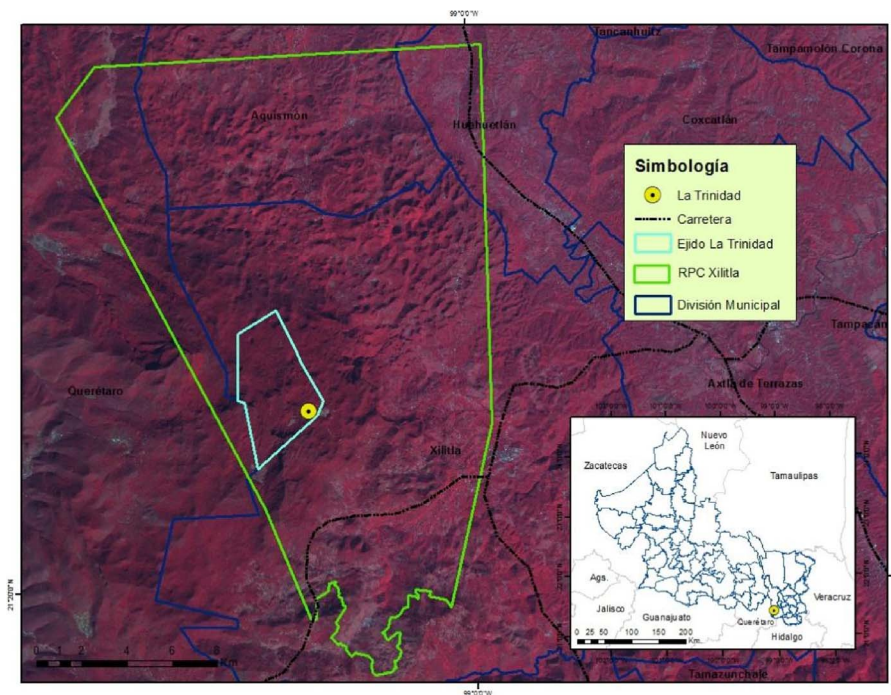


Fig. 2. La Trinidad, within the Municipality of Xilitla – (Newsham et al., 2012a).

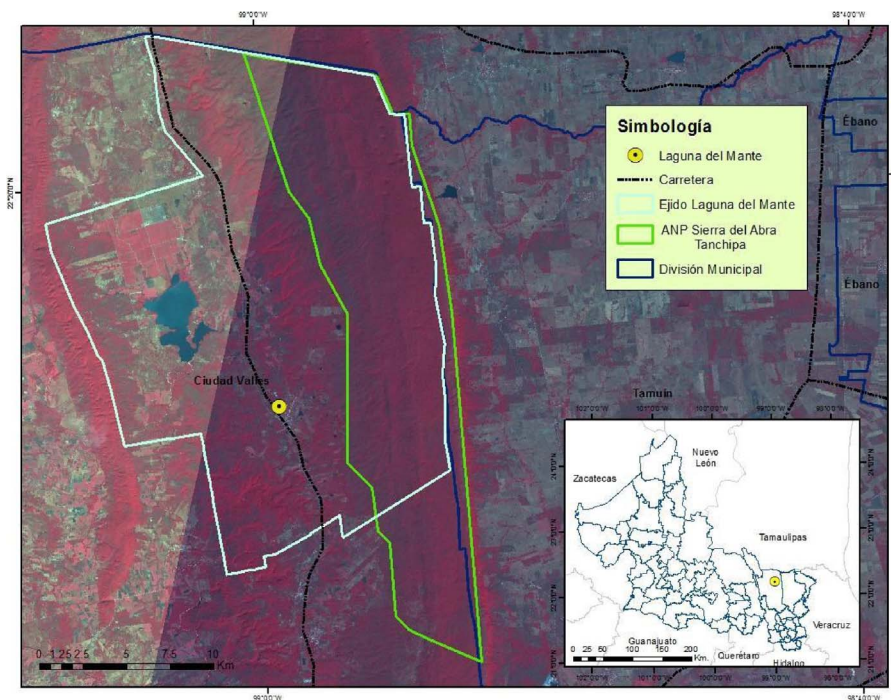


Fig. 3. Satellite Image of Laguna del Mante – (Newsham et al., 2012b).

fieldsites. We maintain that the PAR framework, especially with the ‘access’ component added to it in the second edition of *At Risk* (Blaikie et al., 2004), remains well-suited to exploring them despite having fallen from favour, as a result of debates about how it has fared in the aftermath of the ‘post-modern turn’ in political ecology (see Forsyth, 2008 for a review).

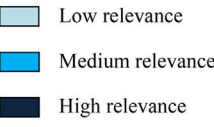
The underlying causal logic of PAR is the ‘progression of vulnerability’: root causes, dynamic pressures and unsafe conditions, in combination with the ‘trigger event’ of an environmental hazard, lead to potentially disastrous outcomes. In our model, this logic remains intact, but we reorient the focus of the analysis with a view to: a) incorporating more centrally the implications of climate change for the

‘progression of vulnerability’, and; b) operationalising the framework methodologically, in the guise of a participatory vulnerability analysis toolkit (Ulrichs et al., 2013). At the heart of our modified PAR model are five ‘dimensions of vulnerability’ (DoV): livelihood strategies, wellbeing, individual capacity, collective capacity and governance. These relate to the characteristics of individuals and households with whom the research was conducted. Each of the five dimensions of vulnerability was assessed by the participatory tool most useful for understanding that particular dimension (see Table 3). The tools were implemented in a particular sequence, to gradually build up and triangulate information collected in groups with semi-structured interviews. The participatory methods were applied over 4–6 days per site in

Table 3

Methods deployed and research questions explored for each dimension of vulnerability (DoV). Colours represent the contribution of each method to generating an understanding of each DoV. The darkest colour indicates the highest level of relevance of the method to a given DoV.

(Adapted from Ulrichs et al., 2013).

	Type of result obtained per tool	Use of results in this paper	Dimension of vulnerability (DoV) and research questions				
			DoV 1 Livelihood strategies	DoV 2 Wellbeing	DoV 3 Individual capacity	DoV 4 Collective capacity	DoV 5 Governance
	<i>Relevance of method to each DoV</i> 		1. What are the social and ecological characteristics of the community? 2. What livelihood strategies are important for the various sub-groups e.g., gender, age, economic status, ethnicity? 3. How are various livelihood strategies affected by climatic impact (including if the livelihood strategies are affected in a differential way)?	1. What are the local criteria for wellbeing? 2. What is the percentage of households within each category of wellbeing? 3. Which households are the most vulnerable and least able to adapt to climatic changes, and why?	1. What levels of access to resources for adaptation do the various groups within the community have? 2. How much control do the various groups have over their resources and livelihoods in order to adapt?	What community norms, practices, and institutions influence the collective vulnerability and the ability to adapt by different groups?	To what extent are the various participants and political organizations involved in climate change capable, responsible, and sensitive to the community?
Transect walk	1. Main ecological and social features. 2. List of natural resources and ecosystem services. 3. Primary zones productive and communal activities.	Narrative sections in 2.2.1, 2.2.2					
Historical timeline	1. Location of main community features, including urban area, agricultural plots, streets, vegetation type, infrastructure. 2. Vulnerability patterns and zones most impacted by climate risk and threat.	Table 4; Narrative section in 3.2.1, 3.2.2					
Wellbeing ranking	1. Wellbeing categories and local criteria to define it. 2. Identification of particularly vulnerable households and analysis of causes.	Narrative in section 3.1.1, 3.2.1 (e.g. <i>Ejidatarios, vecindados</i>)					
Seasonal calendar	1. Seasonality of economic activities and availability of natural resources throughout the year. 2. Climatic impact on productive activities and human responses to it. 3. List of impacts and adaptive capacity throughout seasons.	List of climate-related impacts; Section 3.1.1; 3.2.1; 3.3.1					
Climate shocks ranking	1. Identify significant risk per community. 2. Extent of impact on livelihoods. 3. Adaptive mechanisms and capability at the home and community level.	Table 4. List of climate-related impacts; Section 3.1.1; 3.2.1; 3.3.1					
Venn diagram	List of external organisations and relationship with the community, as well as their ability to help to implement adaptive strategies.	PES & PET info; Section 3.1.2; 3.2.2; 3.3.2					

village-level meetings and were led by a multidisciplinary facilitation team of 10–12 people. Additional days were required for CONANP personnel to announce and organise the visit, as well as for the research team to return to the sites to present our results locally and give residents the chance to cross-check the accuracy of the findings. Fieldwork in these sites was conducted in Spanish.

In order to analyse age and gender-specific aspects of vulnerability, the group exercises were conducted separately with male, female, young and old participants. Table 2 details the methods which comprised the vulnerability analysis toolkit, as well as the number of research participants with which they were used, in both fieldsites. Table 3 presents these methods and relates them to: a) the type of result each tool provided data on; b) where to find coverage of the results of each method in the various sections of this paper; c) the research questions we used to explore each of the five dimensions of vulnerability, at the heart of our conceptual framework; and d) the relative utility (from high to low) of each method for providing data relevant to each dimension of vulnerability. Additional methodological details can be found in CONANP et al. (2014) (Fig. 4).

Whilst a central concern for us was with capturing local perceptions and experiences, we were also aware of a common critique of participatory methods: they do not automatically take into account differentiated access and control over resources by different social groups (Brown, 1999). More concerningly still, from a methodological point of view, the data that can be collected through participatory group exercises is to a great extent contingent upon intra-community power relations which determine what can be said, and by whom, in public settings (Mosse, 1995, 2001; Cooke and Kothari, 2001; Hickey and Mohan, 2004). The use of PRA methods devoid of significant understanding of the context in which they are applied can therefore be ill-

advised. The substantial Mexican expertise in our research team, the gender balance in its composition and the size of it (8 researchers) allowed us to gain relevant insight into salient intra-community differentiations and inequalities, and to a surprising extent counterbalanced the limited time (5 days in each field site) that we were able to spend. We communicated explicitly to research participants our independence from CONANP. Yet whilst in both focus groups and individual interviews, many critical comments were made about CONANP, it is possible, perhaps likely, that some people withheld their full private views from us out of a concern for the consequences of such honesty.

3. Results and discussion

Space does not permit us to cover here the results of the full vulnerability analysis conducted. The focus in this section draws out the broad contours of vulnerability relative to the key climate impacts identified, and the broad social characteristics most relevant to the differentiated and uneven distribution of vulnerability that we found. This lays the foundation for the discussion of the potential relevance and efficacy of payments for ecosystem services (PES) as a mechanism for bringing about ecosystems based adaptation (EBA).

3.1. La Trinidad

3.1.1. Vulnerability and adaptation in La Trinidad

When asked about the most damaging climate-related impacts, the inhabitants of La Trinidad identified six types:

1. Fires, like the 'great fire' of 1998, which resulted in the temporary abandonment of the settlement.

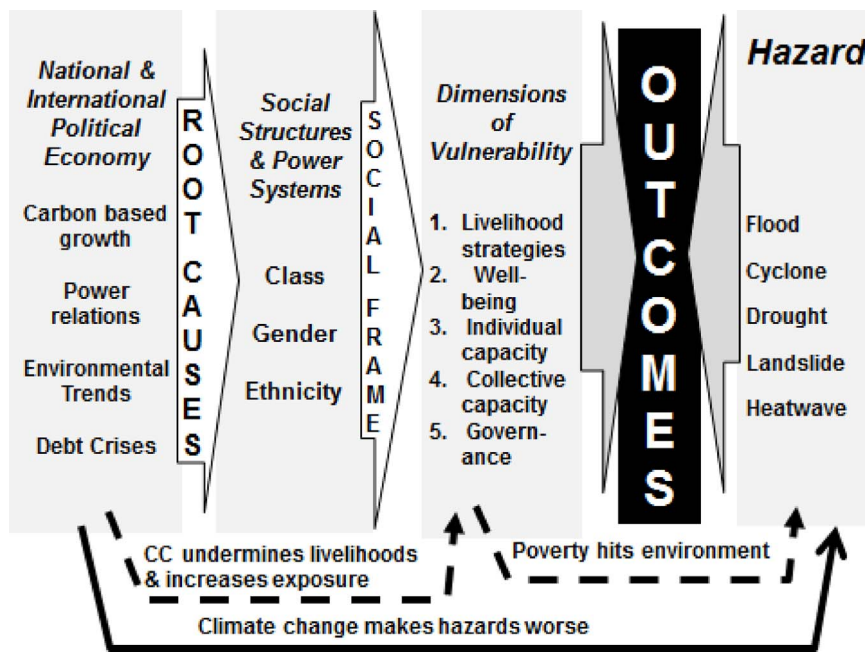


Fig. 4. Modified Pressure and Release model centred on 5 local-level dimensions of vulnerability (Quintero et al., 2012).

2. Frequent hurricanes. Hurricanes Diana of 1992 and Gilberto in 1994 are remembered because they destroyed houses.
3. Frosts have decreased, allowing planting and harvesting twice a year, but there is no certainty that any given year will be free of frost.
4. An increased incidence of pests on crops, and, notably, trees in particular the bark beetle, which attack and kill trees, but which is difficult to treat because the use of pesticides are forbidden within the Reserve.
5. Heavy rainfall and flooding have impact on crops and homes. It was unclear whether their frequency and/or magnitude have increased in recent decades.
6. Decreased water availability is not yet a problem, although there are tensions with 13 neighbouring communities sharing access to the same water sources.

The decreased incidence of frost, the spike in pests and the reduced availability of water may be linked to an increase in average temperatures in recent decades, which is also projected to continue according to climate scenarios for the Sierra Madre Oriental (Magaña et al., 2012). Higher average temperatures may also be associated with the greater incidence of forest fires; although the 'great fire' which loomed heavily in participatory group exercises, was allegedly started by people from another settlement who were burning land to clear it for cultivation.

The individual and collective coping and adaptive strategies displayed by inhabitants of La Trinidad are summarised in Table 4. However, these are more fully understood against the background of a longer history of events and processes that influenced adaptive capacity, dating back to the establishment of the settlement, in 1967. The broad contours are evident in a number of achievements and changes over time:

1. Not only establishing the settlement in the 1960s but having it recognised, in 1990 as an *ejido* (land held in communal tenure), with the attendant rights to residence, government support and facilities that accompany this status.
2. Adjustments to cultivation activities in the face of climate variability over the course of almost 60 years.
3. Substantial change in the make-up of primary livelihood activities. Up until the year 2003, subsistence agriculture, accompanied by livestock keeping and (illegal) timber extraction were prevalent. Thereafter, through closer relations with conservation and forestry agencies, a greater emphasis on revenue generating activities derived from conserving the forest – by reducing agricultural or livestock activities – became more common. This shift away from predominantly agricultural livelihoods came locally to be referred to as *vivir del bosque* (to make a living from the forest), based on receiving payments to prevent forest fires, funded either from the

Table 4

Individual and collective adaptive capacity in relation to identified impacts in field sites. Acronyms: SAGARPA (state agricultural extension), CONAGUA (the National Water Commission).

Field site	Climate impact	Coping and adaptive strategies	
		Individual/household	Collective
La Trinidad	Fires	More selective and fewer cultivation activities	Temporary Employment Programme access
	Hurricanes	Little capacity to respond	Leveraging of political support to resist forced resettlement
	Frosts	Plant and harvest twice a year	Reduced owing to focus on ' <i>vivir del bosque</i> '
	Pests	Constrained by restrictions on pesticide use	Constrained by lack of coordination and resources for dealing with infected trees
	Heavy rainfall/flooding – Water availability	Install concrete floor Little response capacity	Little organised capacity, but good relations with state/federal institutions Contingent upon relations with other communities
Laguna del Mante	Droughts	Dependent on access to irrigation	Good relations with SAGARPA
	Fires	Care in burning land for cultivation	Construction of firebreaks to contain fires; local fire brigade
	Pests and disease	Dependent on access to pesticides	Good relations with SAGARPA
	Heavy rainfall	Limited	Water levels determined by floodgate, operated by CONAGUA

government's Temporary Employment Programme (PET) and payments for environmental services (PES) schemes. Another prominent option has been the ecotourism cabins, supported initially by a local NGO, Grupo Ecológico Sierra Gorda, and subsequently by CONANP. Not all activities changed: for instance, the seasonal migration that had, from the start, supported the establishment of the settlement remains important.

4. The establishment of a well-functioning *Comisariado* (the committee governing the *ejido*) which provides a collective decision-making mechanism. For instance, after the 'great fire' of 1998, the residents of La Trinidad came under significant local political pressure to be resettled outside of the forest reserve. With the support of a local NGO, the *Comisariado* bypassed local municipal and conservation authorities and negotiated directly and successfully with the state governor to be able to return to La Trinidad.

This history demonstrates an existing level of collective capacity to adapt to a variety of shocks and stresses, and it is important to take such capacity into account when considering why payments for ecosystems services appear to be a viable mechanism for ecosystems-based adaptation in this field site.

3.1.2. Ecosystems-based adaptation in La Trinidad

Vivir del bosque (to shift toward livelihood activities which generate a living from the forest, and away from agriculture) in La Trinidad is an example of the potential of PES to be used as an EBA-relevant intervention to generate important social, economic and ecological benefits. Whilst not intended to respond to climate change, PES helps to improve livelihood strategies via partnerships and interactions with national agencies (cf. Wertz-Kanounnikoff et al., 2011). The income people receive, when they procure work with CONAFOR (the state forestry agency) and CONANP (the state conservation agency) in PES and PET (Temporary Employment Program) schemes makes them less dependent on agricultural activities that are highly sensitive to climate impacts. Indeed, in all the group work which asked participants to identify and rank livelihood activities according to importance, income from PES or PET was classified as the second most important. It is this benefit which most clearly contributes to adaptive and coping capacity. It also confers two other important advantages. First, the work is sufficiently remunerative that those involved in such schemes do not need to migrate in search of seasonal agricultural employment, renowned for its gruelling demands on labourers. Second, these schemes are at least partially accessible to women. This is particularly advantageous in a place where income generating activities for women are limited and social assistance coverage of programmes like the *Oportunidades* cash transfer is low. The majority of the community benefits from these programmes to the extent that they could be seen as a viable livelihood strategy; albeit that migration in search of seasonal labour remains necessary for some, because there were not always sufficient funds to offer everyone PES/PET employment. Notwithstanding this caveat, the *ejido* retained the structure of pre neoliberal reform period *ejidos*, in which *ejidatarios* retained an equal share of a communal title. This facilitated a broad sharing of the revenues and employment opportunities from the PES schemes because everyone in La Trinidad was an *ejidatario* or related to one. As such, the use made of this more communal *ejido* structure could be seen as empowering, from the perspective of what it made possible in terms of benefits distribution. This is in stark contrast with the distribution arrangements in Laguna del Mante. Furthermore, there seemed to be scope to strengthen existing *vivir del bosque* activities with complementary funding from programmes for the reduction of bark beetle and REDD+.

Even within this encouraging picture, limitations and trade-offs were also evident. First, a key reason for the strength of adaptive capacity in La Trinidad was that its small population size facilitated collective decision-making and ensured that payments for environmental

services, along with other revenue generating activities associated with *vivir del bosque*, reached many inhabitants, thereby offering more compelling incentives for conservation. The findings from La Trinidad suggest that using PES as an EBA-relevant intervention at this small scale can work, even if questions about its efficacy remain at a larger scale.

Second, although the families of La Trinidad have adapted to new circumstances individually and collectively, considerations of gendered power relations have to be taken into account in understanding the distribution of adaptive capacity across the community. Women had less access to job opportunities and the inheritance of land, and lacked political representation. Men control the *Comisariado* and also the political relations with State authorities, because only male household heads are recognised as *ejidatarios*. Women were clearly marginalised by this dominance, and expressed dissatisfaction with it. For instance, the CONANP Forest Reserve director who was so instrumental to procuring access to PES and PET programmes insisted on women being employed in them. Yet women's participation was criticised and, by some accounts, constrained by key *Comisariado* members on the grounds that they could not care for their children properly when at work.

Third, there is a clear trade-off arising from the extent to which the *vivir del bosque* strategy involves the restriction of "traditional" agricultural activities, as evidenced by the reforestation of land that was previously farmed, and by the abandonment of cattle herding. This reflects power relations that determine how and who defines what is compatible or not, with conservation objectives. This was decided more by CONANP than by the community. Yet whilst the *Comisariado* clearly supported activities associated with *vivir del bosque*, interviews and focus group discussion indicated that some community members would have preferred greater autonomy over using the *ejido* land for farming. Good relations with CONANP also have other costs, given the role it plays as a 'gatekeeper' in permitting the access of other government agencies and services. For instance, CONANP staff working in La Trinidad had been unwilling to allow SAGARPA, the state agricultural extension agency, to enter, for fear they would conflict with the conservation objectives of the reserve. They had also favoured the introduction of solar panels over extending the electricity grid, despite the fact that the panels did not meet local electricity demand and were unreliable. Whilst understandable from a conservation perspective, there are trade-offs posed by these restrictions which create both winners and losers, and alternative adaptation strategies around agricultural activities which could not be considered. The concern, then, is that framing adaptation in La Trinidad in terms of EBA from the outset, as CONANP has done, privileges one set of adaptation responses even as it discourages consideration of others, and masks political contests over whose livelihood strategies receive support.

Fourth, the growing incidence of bark beetle in the forest, with fundamental implications for tree health, had CONANP staff concerned about its potential to expand exponentially: the area of forest that the beetle had been found in had increased from 50 ha to 400 ha within the space of a year. The heightened occurrence of the bark beetle was held to be a result of the higher temperatures and milder winters which were no longer cold enough to kill off these pests. Ironically, therefore, the gains in adaptive capacity that are currently offered to those receiving income from the PES and PET schemes may be threatened by bark beetle which, if left unchecked, could decimate the entire reserve. If that were to happen, then *vivir del bosque* could cease to be a viable adaptation strategy.

Finally, revenue from the PET and PES schemes was not guaranteed to be available over the medium and long term. Nor had the ecotourism cabins become financially self-sustaining at the time of fieldwork, raising questions over the medium and long-term future of 'living from the forest.'

3.2. Laguna del Mante

3.2.1. Vulnerability and adaptation in Laguna del Mante

The main climate-related events mentioned by local residents in Laguna del Mante were:

1. Droughts, which affect sugar cane, corn and bean cultivation, as well as cattle farming. Although sugar cane is well adapted to dry conditions, some extreme events – such as the 2011 drought – surpass the crop endurance threshold
2. Fires, which are part of sugar cane cultivation practices, often flare out of control, threatening biodiversity and crops, and are also blamed for health problems. Whilst, therefore, not always climate related, fire dynamics can be influenced by rising temperatures
3. Pest and disease incidence appears also to have increased with rising temperatures, and sugar cane is frequently vulnerable to both
4. Heavy rainfall, less common than drought, is a concern for farmers who report that it damages the lemon flower bud, decreasing yield.

The four types of local landholders recognised by the residents have different rights and obligations in the ejido, access to resources and vulnerability profiles differentiated primarily by their land tenure status but also by gender. *Ejidatarios* (inhabitants with recognised communal tenure rights in the ejido), who are mostly male, enjoy exclusive privileges: speaking and voting rights in the local assembly; eligibility to receive PES benefits; and 60 ha of land per person. However, *ejidatarios* have to care for the *ejido*, which reduces their availability to migrate seasonally to the USA to work. *Hijos de ejidatarios* (sons of *ejidatarios*) can access land through inheritance, purchase or sharing with their *ejidatario* parent. They often migrate to work in big cities but work the land if they stay in the village. *Posesionarios* are persons who live outside the *ejido*, but own private land holdings of up to 300 ha. These properties were purchased from *ejidatarios*, and are mainly used for livestock farming. The most marginalised group are the *avecindados*, migrants to Laguna del Mante who generally do not own land and sell their labour to *posesionarios* or *ejidatarios*. *Avecindados* do not have *ejido* obligations, leaving them free to migrate to work elsewhere, an advantage according to local perception. Many *avecindados* and some *hijos de ejidatarios* work in the citrus fruit industry or on sugar cane plantations, but some sell food, wares or services (such as fixing tyres) by the side of the highway adjacent to the entrance to the main settlements in Laguna del Mante.

Vulnerability to climate impacts differs between these social groups, and is affected by direct and indirect adverse impacts on livelihoods. Across the groups the most vulnerable are those whose livelihoods are most dependent on agricultural activities. This includes former *ejidatarios* who have sold their land and those *avecindados* who work the land of another owner, because their jobs depend on the availability of farm work, which is highly affected by climate impacts. *Ejidatarios* with land are also vulnerable because their livelihood revolves around agricultural activities.

Economic activities are not only influenced by land tenure categories (*ejidatario*, *avecindado* etc.), but also by gender. While men tend to work predominantly in agricultural activities, which are most vulnerable to climate impacts, women work in commercial activities, non-farm income generating activities and at home. Both women and men work in cane farming, encouraged by government support for a women's association. Male-dominated activities are thus more exposed to climate impacts, which has an indirect impact on women who need to diversify their income-generating activities to compensate for household income losses incurred through lower agricultural output. Against these difficulties, farmers in Laguna del Mante have much better access to and, thereby, relations with SAGARPA, the government agricultural extension agency, than their counterparts in La Trinidad. They receive assistance with the pests associated with higher temperatures experienced in recent years, as well as with advice on plant varieties best

adapted to these changing conditions. This important difference between the field sites demonstrates the extent to which CONANP does not yield quite the same power to affect livelihood strategies in Laguna del Mante as it does in La Trinidad. The adaptive and coping responses are summarised in Table 4.

3.2.2. Ecosystems-based adaptation in Laguna del Mante

PES is offered for particular conservation activities related to El Abra Tanchipa Biosphere Reserve. Principally, these consist of patrolling and monitoring activity within the Biosphere Reserve, and creating and maintaining firebreaks between the Reserve and cultivated land. There are also payments made, via the PET (Temporary Employment Programme), which fund the provision of a fire brigade, seasonal maintenance of the fire break and monitoring activities within the Biosphere Reserve. These fire brigade and firebreak maintenance provisions are valued not just for the protection they afford the Reserve, but also because of the threat to life and property posed by burning land for cultivation purposes. Securing income-generating activities which also have such clear local benefits has allowed CONANP to cultivate good relations with local leaders and, albeit to a much lesser extent, some residents in Laguna del Mante. As in La Trinidad, to the extent, therefore, that these payments provide income to some residents and reduce dependency upon climate-sensitive livelihoods, they can be considered EBA-relevant.

However, there are numerous factors which impinge upon the efficacy of this type of intervention. First, payments amounted to approx. US \$50/*ejidatario*/year (2012 prices), which research participants agreed, both in participatory group work and individual interviews, was an insignificant contribution to household income. There is little evidence to suggest that the size of payments leveraged from the Abra Tanchipa Biosphere Reserve is sufficient to make *ejidatarios* consider the reserve a better option than, say, expanding the agricultural frontier. Agriculture continues to provide the mainstay of household income for *ejidatarios* and *avecindados*. At present, the area would still need to be protected by law, rather than offering sufficient incentive to *ejidatarios* to make them desirous of its continued presence. Additionally, payments are restricted to *ejidatarios* (constituting an estimated 20% of the population, although including their families the proportion rises to 70%). Moreover, similar concerns about gendered power relations acting on access to benefits from PES/PET as those witnessed in La Trinidad also surfaced in Laguna del Mante, in three ways. First, *ejidatarios* were almost exclusively men. Second, men dominated the *Comisariado*. Third, it was mostly men who were given paid employment in the fire brigade or working on firebreak maintenance. *Avecindados* (estimated to be 20% of the population) are ineligible. Many do not even know of the payments, which, therefore, do not influence their resource use behaviour: illicit trading of wood and illegal harvesting of plants from the Reserve is held locally to be widespread. Indeed, some *avecindados* felt obliged to cut wood in the Reserve because they did not have the permission of *ejidatarios* to extract it from their privately-owned parcels. As in La Trinidad, then, the empowering effects of holding land tenure were evident for some actors, in terms of the benefits they received, but the disempowering effects, for those with no legal standing within the *ejido*, are clearer to see.

Further, there was little scope to increase the size of the payments. Laguna del Mante could not apply for carbon forestry and other PES schemes because the level of revenues already received from existing activities meant, according to the Park Director, that they were ineligible for further subsidy.

Compounding this difficulty, land use regulations provoked a trade-off between preserving biodiversity with high conservation value and potentially EBA-relevant cropping strategies. Current regulations prohibited options such as the cultivation of biofuels or other commercially viable crops such as ponytail palms (*Beaucarnea recurvata*). Indeed, biodiversity outside the reserve was ineligible for PES, regardless of EBA or commercial potential. Those receiving PES, in other words, not

included in the processes through which the conservation value of particular forms of biodiversity was defined or assigned, and in consequence saw some adaptation potential options effectively ruled out. The concern, then, is that the politics of knowledge production around valued biodiversity, act effectively as a power relation with clearly exclusionary effects in this case.

Situating EBA in a broader context, decisions about water management may have more profound implications for livelihoods and for adaptation than do the PES schemes related to the biosphere reserve. Cane and lime are the main income-generating crops in Laguna del Mante. Cane is drought-resistant and retains a consistent, year-round selling price, providing economic security. The lime industry brings in perhaps the greatest amount of local wages, but it is controversial because it requires large volumes of water and receives priority in terms of water provision. While the reservoir, Presa La Lajilla, is the engine of the local economy, its management also courts controversy. According to information provided by key informants, before the onset of the rainy season, the state water agency, CONAGUA opens the floodgate to prevent flooding in the nearby city of Ciudad Valles. Locally, people claimed that this constrains cultivation and can even leave them short of drinking water because water is available only twice per week (although we were unable to verify this claim independently). These claims raise the concern that key livelihood prospects in Laguna del Mante are traded-off against flood protection for Ciudad Valles inhabitants. Ultimately, their lack of involvement in decisions over the levels at which to leave the water, and the seeming lack of consideration of the consequences for them, weakens rather than strengthens their own resilience.

Through all of these issues can be traced the influence of access to land, as governed by land tenure status and reform. Not only did these factors determine eligibility for PES, but *ejidatarios* tended to be given employment in the fire brigade, fire break and reserve monitoring activities. The costs of conservation restrictions on resource use, which PES are an attempt to compensate for, fall more heavily on *avecindados* than *ejidatarios*, who are already more marginalised within the decision-making structures of the *ejido*. The neoliberal reforms which led Laguna del Mante to be divided up into individual, titled property parcels also underpin the uneven distribution of benefits from PES and restrictions on water owing in part to the presence of the privately-owned citrus plantation. They may also have weakened the bargaining power *ejidatarios* have with CONAGUA, when it comes to setting the water levels at different times of year. The contrast with arrangements in La Trinidad is instructive. Whilst the lack of control over key resource use is to some extent also seen in La Trinidad, there is a significantly more equitable distribution of benefits in La Trinidad, partly owing to the smaller size of the settlement but also because it still operates as a communal *ejido*. Therefore, the effects of neoliberal reform, in this regard, appear to have had adverse implications for the prospects for payments for ecosystem services for serving as a conduit to ecosystems-based adaptation.

4. Conclusions

In conclusion, in the context of using payments for ecosystem services to achieve ecosystems-based adaptation for people living in and adjacent to protected areas in Mexico's Sierra Madre Oriental, we contend that it would be unfair to argue that we are 'being conned', to return to Potter's sceptical question (1997). It is too early to say to what extent CONANP, Mexico's national protected area commission, will in practice be able to help SMO residents, living in or adjacent to protected areas, to adapt to climate change. Yet CONANP has shown strong commitment to developing a national adaptation strategy and invested substantially in developing its own capacity to understand local level climate vulnerabilities. These demonstrate the concern held by CONANP not just for biodiversity but for the people whose lives are most intimately connected to its conservation. Further, our evidence

suggests that PES can yield EBA-relevant benefits, albeit so far only at a very small scale. In La Trinidad, existing PES schemes a) offer income streams which reduce dependency on climate sensitive livelihood activities; b) increase options to avoid incorporation into immiserating forms of seasonal migration; and c) contribute to some of CONANP's most central conservation objectives in the area.

However, there is also clear evidence that, at least in the context of protected area management, there is a risk of a trade-off between favouring EBA over other kinds of adaptation measures would be at least as – and quite possibly more – relevant. The provision of adaptation support around agricultural activity in La Trinidad, for instance, was ruled out by the choice of EBA to frame the kinds of intervention that would be deployed in the first place. Most crucially of all, as we see in Laguna del Mante, there are significant constraints which impinge fundamentally on the efficacy of payments for ecosystem services to be EBA-relevant. Even aside from the issues arising from the fact that only *ejidatarios*, not *avecindados*, have any incentive to modify their use of biodiversity within the Abra Tanchipa Biosphere Reserve, the payments offered look meagre in comparison with the potential returns from expanding the agricultural frontier. This is another example of a broader phenomenon, which we might term NEPES ('not enough payment for ecosystem services'), which is well documented within the PES literature (Kosoy and Corbera, 2010; Guzmán et al., 2011; Farrell, 2014). Our study shows how the people living adjacent to Protected Areas are constrained in their use of natural resources (Ruiz-Mallén et al., 2015), thereby transferring the conservation cost to local human populations. Especially in the context of Laguna del Mante, the benefits from PES do not appear to compensate sufficiently for these costs.

This difficulty – of insufficient reward (financial or otherwise) – is by no means new. It was one amongst a number of potentially terminal problems identified with the integrated conservation and development projects of the 1990s (see, for instance, Emerton et al., 2001 for a pithy account of the failure of wildlife conservation to provide sufficient local economic benefit across many African countries). It is in many ways to be expected. Its sheer predictability is the main reason why the lack of consideration given to it within the EBA literature is cause for concern. Perhaps we do the concept no favours by building in such high expectations of what EBA can achieve; yet that is the frequent effect of much of the literature on EBA. The most important lesson to be derived from the experiences with ICDPs, and which is borne out in our research findings, is to problematise the notion of win-win. Both conservation and development practitioners have frequently concluded that conservation and/or development objectives suffer when trying to do both. Wide-ranging reviews have signalled the difficulties that many ICDPs did not overcome (Wells et al., 1992, 1999; Newmark and Hough, 2000; McShane and Wells, 2004; Roe, 2008). The concept of the trade-off offers much greater analytical purchase when attempting to understand the relationship between conservation and development. Successors to the thinking of the 1990s, such as the 'new conservation debate', compellingly argue that trade-offs remain a better predictor of the outcomes of combined conservation and development intervention than does the idea of synergy (McShane et al., 2011; Minter and Miller, 2011; Salafsky, 2011). Set against this background, the credibility of win-win claims made by some EBA proponents appear tenuous, especially when considered against the difficulties encountered in our field sites. We argue, therefore, that a closer engagement with the 'new conservation debate' and its ICDP forebears, and a shift in focus from hypothetical to intervention-related benefits and, crucially, costs, would make for useful next steps in the ecosystems-based adaptation research agenda. Our empirical work in Mexico offers an early contribution to tracing its contours.

Important though the new conservation debate's emphasis on trade-offs is, however, it does not pose the question as to *why* these trade-offs, seen in the ICDP literature, in our fieldsites and in many other contexts, are *globally* prevalent, and indeed more likely than synergy. In further deepening the EBA research agenda, we would do well to draw on the

insights of political ecologists, and critical environmental scholarship more broadly. A number of scholars have argued that we have a global neoliberal² political economy which: a) tends to privilege economic growth over all other policy considerations; b) looks to the market as the means through which to achieve prosperity and development through the establishment of private property regimes; c) is associated with a weakening of state power; and d) serves the interests of capital accumulation more effectively than the achievement of human well-being, or the equitable distribution of the benefits of economic activity (Sklair, 2001; Harvey, 2007; Newell, 2008). Arguably, these conditions reduce the space available for alternative visions which might serve either environmental, poverty reduction or wellbeing objectives, including the win-win scenarios prized by many EBA commentators.

The most visible aspect of this agenda in our fieldsites is the effect of land tenure reform along neoliberal lines, which has divided the Laguna del Mante *ejido* into smaller, private parcels. These reforms have excluded those who are not *ejidatarios*, or not related to them, from the benefits of payments for ecosystem services, thereby operating as a constraint on adaptation. Another visible aspect was the decrease in water quantity and/or quality in both study sites. While this seems to be due to an interplay between declines in rainfall, climate change and increase in human populations, our research suggests that the same neoliberal land reform policies have also contributed. Evidence of this is the hoarding of land with available water by the most powerful economic groups, such as the citrus companies in Laguna del Mante.

A growing body of literature charges that influential conservation actors have inadvertently embraced neoliberal capitalism as the means through which to 'save nature' (Sullivan, 2006; Brockington and Duffy, 2010; Brockington et al., 2010; Duffy, 2010; Buscher and Arsel, 2012). This strategy may conceivably be self-defeating, to the extent that it is "inherent in neoliberal capitalism to discount...the value of nature" (Newsham and Bhagwat, 2016, p. 4) even though the system is built on what Castree (2008) has referred to as the commodification of nature. Commodifying nature, and simultaneously giving it insufficient value (economic or otherwise) to ensure that what humans need from it remains available, is the contradiction currently at the heart of neoliberal capitalism. PES commentators like Wertz-Kanounnikoff et al. (2011) allude to this conundrum when identifying EBA adaptation benefits that nobody wants to pay for. However, they do not make the link to the fundamental point that it is the workings of capital accumulation which determine what will or will not be paid for, and that unless underlying dynamics of capital accumulation change, and the interests served by these dynamics confronted, it is difficult to see how such benefits will ever be paid for. One expression of this conundrum is that neoliberal capitalism is fundamentally implicated in the production of global climate change and, thereby, of the climate impacts witnessed in our fieldsites. The prospects for ecosystems based adaptation – and reconciling conservation and development more broadly – hinge upon whether this global political and economic system can be reformed to resolve this contradiction, or whether it is an inherent and inevitable consequence of neoliberal capitalism and, therefore, not susceptible to reform.

These considerations are mirrored in the work of scholars keen to better theorise the politics of adaptation. Some have questioned whether incremental adaptation, to ensure the current system or status quo can retain form and function in the face of external shocks and stresses such as climate impacts, should really be the object of development; especially if 'development' remains a byword for economic growth (Boyd et al., 2009; Brown, 2011). The concern is that making incremental adjustments perpetuates, rather than confronts, processes which

entrench and perpetuate vulnerability to climate impacts; and indeed to poverty and marginalization more broadly (Pelling, 2011; Inderberg et al., 2015). This has led on the part of some to calls for transformative adaptation (Pelling, 2011; O'Brien, 2012) which, in a more radical guise, might look for inspiration toward the explicitly anti-capitalist philosophy and movement 'de-growth' (cf. D'Alisa et al., 2014). Whatever form it takes, it will be crucial for the prospects for transformative adaptation – and indeed for its theorisation – to understand the uneven socio-natural effects of capitalism as an essentially political process (Taylor, 2014; Eriksen et al., 2015). More fundamental engagement with politics at this level is required in our thinking, essentially, about responding to climate change (ibid.).

For the authors of this paper, it remains an open question as to whether neoliberal capitalism is susceptible to incremental reform, or whether more radical transformation is required. But it is telling that these considerations are yet to surface in the EBA literature, even in recent contributions which call for EBA to play a role in transformative adaptation (i.e. Brink et al., 2016; Huq et al., 2017). If we want to understand the prospects for achieving the conditions under which conservation and development synergies can become more prevalent than trade-offs, and thereby work towards the prospect of realising the potential of EBA, these debates provide important resources for future research in this area. Our research is an attempt at providing an early empirical contribution to this agenda.

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References

- Adams, J.S., McShane, T.O., 1992. *The Myth of Wild Africa: Conservation Without Illusion*. University of California Press, Berkeley.
- Adams, W., Hulme, D., Murphree, M., 2001. *Changing narratives, policies and practices in African conservation: The Promise & Performance of Community Conservation*. James Currey, Oxford.
- Adams, W.M., Aveling, R., Brockington, D., Dickson, B., Elliott, J., Hutton, J., Roe, D., Vira, B., Wolmer, W., 2004. Biodiversity conservation and the eradication of poverty. *Science* 306, 1146–1149.
- Alongi, D.M., 2008. Mangrove forests: resilience, protection from tsunamis, and responses to global climate change. *Estuar. Coast. Mar. Sci.* 76 (1), 1–13.
- Andrade, A., Herrera-Fernandez, B., Cazzolla Gatti, R., 2010. *Building Resilience to Climate Change: Ecosystem-Based Adaptation and Lessons from the Field*. (Gland, Switzerland: IUCN. No. 9).
- Appendini, K., 2008. *La regularización de la tierra y la resolución de conflictos: el caso de México*. Instituciones y Desarrollo: Ensayos Sobre la Complejidad del Campo Mexicano. Centro Regional de Investigaciones Multidisciplinarias, Universidad Nacional Autónoma de México, México, pp. 225–249.
- Berkes, F., Colding, J., Folke, C., 2008. *Navigating Social-Ecological Systems: Building Resilience for Complexity and Change* [Online]. Cambridge University Press, Cambridge, New York (Available from: <http://site.ebrary.com/lib/aberdeenuniv/Doc?id=10069848>).
- Berkes, F., 2008. *Sacred Ecology*. Routledge, New York.
- BirdLife International, 2009. *Partners with Nature: How Healthy Ecosystems Are Helping the World's Most Vulnerable Adapt to Climate Change* [Online]. BirdLife International, Cambridge. Available from: http://www.birdlife.org/sites/default/files/attachments/Ecosystemsandadaptation_0.pdf (Accessed 19 November, 2015).
- Blaikie, P., Cannon, T., Davis, I., Wisner, B., 2004. *At Risk: Natural Hazards People's Vulnerability and Disasters*. Routledge.
- Blaikie, P.M., 1999. A review of political ecology: issues, epistemology and analytical narratives. *Z. für Wirtschaftsgeographie* 43 (3/4), 131–147.
- Boyd, E., Grist, N., Juhola, S., Nelson, V., 2009. Exploring development futures in a changing climate: frontiers for development policy and practice. *Dev. Policy Rev.* 27, 659–674.
- Bood Nadia, 2012. 'Opportunities for triple-wins development in coastal Belize'. WWF Briefing paper, funded by CDKN, 4p. Available from: www.greengrowthknowledge.org.

² We follow David Harvey's definition of 'neoliberalism': "A theory of political economic practices that proposes that human well-being can best be advanced by liberating individual entrepreneurial freedoms and skills within an institutional framework characterised by strong private property rights, free markets, and free trade" (Harvey, 2007, p. 2)

- org/sites/default/files/downloads/resource/Opportunities_for_triple-wins_development_in_coastal_Belize_CDKN_WWF.pdf (accessed 23.01.18).
- Brandon, K., Wells, M., 1992. Planning for people and parks – design dilemmas. *World Dev.* 20 (4), 557–570.
- Brink, E., Aalders, T., Adam, D., Feller, R., Henselek, Y., Hoffmann, A., Ibe, K., Matthey-Doret, A., Meyer, M., Negrut, N.L., Rau, A.-L., Riewerts, B., von Schuckmann, L., Tornros, S., von Wehrden, H., Abson, D.J., Wamsler, C., 2016. Cascades of green: a review of ecosystem-based adaptation in urban areas. *Glob. Environ. Change Hum. Policy Dimens.* 36, 111–123.
- Brockington, D., Duffy, R., 2010. Capitalism and conservation: the production and reproduction of biodiversity conservation. *Antipode* 42, 469–484.
- Brockington, D., Duffy, R., Igoe, J., 2010. *Nature Unbound: Conservation, Capitalism and the Future of Protected Areas*. Earthscan, London.
- Brockington, D., 2002. *Fortress Conservation: The Preservation of the Mkomazi Game Reserve, Tanzania*. The International African Institute in association with James Currey, Oxford; Mkuki Na Nyota, Dar es Salaam; Indiana University Press, Bloomington & Indianapolis, London.
- Brown, D., 1999. *Principles and Practice of Forest Co-Management: Evidence from West-Central Africa*. European Union Tropical Forestry Paper 2. ODI (Available at <https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/5688.pdf> (Accessed 20 December, 2017)).
- Brown, K., 2004. Trade-off analysis for integrated conservation and development. In: McShane, T.O., Wells, M.P. (Eds.), *Getting Biodiversity Projects to Work*. University of Columbia Press, Chichester, New York, pp. 232–255.
- Brown, K., 2011. Sustainable adaptation: an oxymoron? *Clim. Dev.* 3 (1), 21–31.
- Buscher, B., Arsel, M., 2012. Introduction: neoliberal conservation: uneven geographical development and the dynamics of contemporary capitalism. *Tijdschrift Voor Economische En Sociale Geografie* 103, 129–135.
- CONANP, GIZfhedh, GmbH, 2014. Herramienta para analizar vulnerabilidad social a impactos de Cambio Climático en áreas naturales protegidas de México [Online]. Comisión Nacional de Áreas Naturales Protegidas – Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, México (Available from: http://cambioclimatico.conanp.gob.mx/documentos/Herramienta_Vulnerabilidad_Social_completa.pdf [Accessed 6 May, 2016]).
- Comisión Nacional de Áreas Naturales Protegidas - Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, 2013. Programa de Adaptación al Cambio Climático Región Central de la Sierra Madre Oriental. CONANP, GIZ, México (Available from: <http://cambioclimatico.conanp.gob.mx/documentos/PACCESMO.pdf> [Accessed 14 Oct 2013]).
- Cannon, T., Schipper, L. (Eds.), 2014. *World Disasters Report 2014: Focus on Culture and Risk* [Online]. International Federation of Red Cross and Red Crescent Societies, Geneva, Switzerland. Available from: <http://www.ifrc.org/world-disasters-report-2014> (Accessed 6 May, 2016).
- Castree, N., 2008. Neoliberalising nature: processes, effects, and evaluations. *Environ. Plann. A* 40 (1), 153–171.
- Cooke, B., Kothari, U., 2001. *Participation: The New Tyranny?* Zed Books, London.
- Costanza, R., de Groot, R., Sutton, P., van der Ploeg, S., Anderson, S.J., Kubiszewski, I., Farber, S., Turner, R.K., 2014. Changes in the global value of ecosystem services. *Glob. Environ. Change* 26, 152–158.
- D'Alisa, G., Demaria, F., Kallis, G. (Eds.), 2014. *Degrowth: A Vocabulary for a New Era*. Routledge.
- Doswald, N., Munroe, R., Roe, D., Giuliani, A., Castelli, I., Stephens, J., Moeller, I., Spencer, T., Vira, B., Reid, H., 2014. Effectiveness of ecosystem-based approaches for adaptation: review of the evidence-base. *Clim. Dev.* 6 (2), 185–201.
- Duffy, R., 2010. *Nature Crime: How We're Getting Conservation Wrong*. Yale University Press.
- Durand-Alcántara, C.H., 2009. *Del Derecho Agrario Y El Problema Agrario En México*. Porrúa, México.
- Emerton, L., Hulme, D., Murphree, M., 2001. The nature of benefits and the benefits of nature: why wildlife conservation has not economically benefitted communities in Africa. *African Wildlife and Livelihoods*. James Currey, Oxford, pp. 208–226.
- Eriksen, S.H., Nightingale, A.J., Eakin, H., 2015. Reframing adaptation: the political nature of climate change adaptation. *Glob. Environ. Change* 35, 523–533.
- Fairhead, J., Leach, M., 1998. *Reframing Deforestation: Global Analysis and Local Realities: Studies in West Africa*. Routledge, London & New York.
- Farrell, K.N., 2014. Intellectual mercantilism and franchise equity: a critical study of the ecological political economy of international payments for ecosystem services. *Ecol. Econ.* 102, 137–146.
- Folke, C., Gunderson, L., 2012. Reconnecting to the biosphere: a social-ecological renaissance. *Ecol. Soc.* 17 (4).
- Forsyth, T., 2003. *Critical Political Ecology: The Politics of Environmental Science*. Psychology Press.
- Forsyth, T., 2008. Political ecology and the epistemology of social justice. *Geoforum* 39 (2), 756–764.
- Gunderson, L.H., Holling, C.S., 2002. *Panarchy: Understanding Transformations in Human and Natural Systems*. Island Press, Washington D.C., London.
- Guzmán, G., González de Molina, M., Alonso, A.M., 2011. The land cost of agrarian sustainability. An assessment. *Land Use Policy* 28, 825–835.
- Harvey, D., 2007. *A Brief History of Neoliberalism*. Oxford University Press.
- Hickey, S., Mohan, G., 2004. *Participation: From Tyranny to Transformation? Exploring New Approaches to Participation in Development*. Zed, London.
- Hulme, D., Murphree, M., 2001. Community conservation in Africa: an introduction. *African Wildlife and Livelihoods: The Promise and Performance of Community Conservation*. James Currey, Oxford, pp. 1–8.
- Huq, N., Bruns, A., Ribbe, L., Huq, S., 2017. Mainstreaming ecosystem services based climate change adaptation (EbA) in Bangladesh: status challenges and opportunities. *Sustainability* 9 (6), 926.
- INEGI (Instituto Nacional de Estadística Geografía e Informática), 2018. Mapa Digital De México. (Available from: <http://www.inegi.org.mx/geo/contenidos/mapadigital/> [Accessed 08 Jan 2017]).
- Inderberg, T.H., Eriksen, S., O'Brien, K., Sygna, L., 2015. *Climate Change Adaptation and Development: Transforming Paradigms and Practices*. Routledge.
- Kosoy, N., Corbera, E., 2010. Payments for ecosystem services as commodity fetishism. *Ecol. Econ.* 69, 1228–1236.
- Leach, M., Scoones, I., Stirling, A. (Eds.), 2010. *Dynamic Sustainabilities: Technology, Environment, Social Justice*, first edition. Routledge, London, Washington, DC.
- Magaña, V., Galván, L.M., Gómez, L., 2012. Escenarios de Cambio Climático en la región de Sierra Madre Oriental. Universidad Nacional Autónoma de México, México D.F. (Report submitted for GIZ-CONANP 'Project Climate Change and Management of Protected Natural Areas PN: 10.9070. 3-001.00).
- Martínez Alonso, C., Locatelli, B., Imbach, P., Vignola, R., (Eds.), 2010. *Adaptación al cambio climático y servicios ecosistémicos en América Latina. Libro de actas del seminario internacional SIASSE 2008. CATIE Technical Series Manual No. 99*. 144p. Available from http://agents.cirad.fr/pjijmg/bruno.locatelli@cirad.fr/Martinez_2010_Adaptation_servicios_ecosistemicos.pdf (accessed 23.01.18).
- McShane, T.O., Wells, M.P., 2004. In: McShane, T.O., Wells, M.P. (Eds.), *Integrated Conservation and Development*. Columbia University Press, New York, Chichester, pp. 3–9.
- McShane, T.O., Hirsch, P.D., Trung, T.C., Songorwa, A.N., Kinzig, A., Monteferri, B., Mutekanga, D., Thang, H.V., Dammert, J.L., Pulgar-Vidal, M., Welch-Devine, M., Peter Brosius, J., Coppolillo, P., O'Connor, S., 2011. Hard choices: making trade-offs between biodiversity conservation and human well-being. *Biol. Conserv.* 144 (3), 966–972.
- Mensah, et al., 2012. Making the Case for Ecosystem-Based Adaptation: Building Resilience to Climate Change [Online]. UNEP, UNDP, IUCN, Nairobi. Available from: <http://www.seachangeop.org/node/2951> (Accessed 08 February, 2017).
- Minter, B.A., Miller, T.R., 2011. The new conservation debate: ethical foundations, strategic trade-offs, and policy opportunities. *Biol. Conserv.* 144 (3), 945–947.
- Mosse, D., 1995. *Social analysis in participatory rural development*. PLA Notes, 24.
- Mosse, D., 2001. People's knowledge, participation and patronage: operations and representations in rural development. *Participation: The New Tyranny?* Zed Books, London, pp. 16–35.
- Munang, R., Thiaw, I., Alverson, K., Mumba, M., Liu, J., Rivington, M., 2013. Climate change and ecosystem-based adaptation: a new pragmatic approach to buffering climate change impacts. *Curr. Opin. Environ. Sustain.* 5 (1), 67–71.
- Munroe, R., Roe, D., Doswald, N., Spencer, T., Möller, I., Vira, B., Reid, H., Kontoleon, A., Giuliani, A., Castelli, I., Stephens, J., 2012. Review of the evidence base for ecosystem-based approaches for adaptation to climate change. *Environ. Evid.* 1 (1), 13.
- Murombedzi, J., 1992. Decentralisation or Recentralisation? Implementing Campfire in the Omay Communal Lands of the Nyaminyami District. University of Zimbabwe, Harare (CAS Occasional Paper).
- Murphree, M., 1997. Congruent Objectives, Competing Interests and Strategic Compromise: Concept and Process in the Evolution of Zimbabwe's Campfire Programme. Institute for Development Policy and Management, University of Manchester (Community conservation research in Africa Paper no. 2).
- Neumann, R.P., 1997. Primitive ideas: protected area buffer zones and the politics of land in Africa. *Dev. Change* 28, 559–582.
- Newell, P., 2008. The political economy of global environmental governance. *Rev. Int. Stud.* 34 (3), 507–529.
- Newmark, W.D., Hough, J.L., 2000. Conserving wildlife in Africa: integrated conservation and development projects and beyond. *Bioscience* 50 (7), 585–592.
- Newsham, A.J., Bhagwat, S., 2016. *Conservation and Development* [Online]. Routledge, Abingdon, Oxon. Available from: <https://www.routledge.com/products/9780415687812> (Accessed 09 February, 2017).
- Newsham, A., Pulido-Silva, M.T., Muñoz Cruz, R., Ulrichs, M., Camacho Castillo, E., Cantellano Ocón, X., Gonzalez Áviles, B.Y., Shankland, A., 2012a. Análisis de los resultados de la aplicación de herramientas de metodología participativa para el análisis de vulnerabilidad de estrategias de vida (AVEV) al cambio climático: Comunidad de La Trinidad, Xilitla, San Luis Potosí. Institute of Development Studies, Universidad Autónoma del Estado de Hidalgo, Universidad Iberoamericana de Puebla, GIZ, Brighton, UK (Report submitted for GIZ-CONANP 'Project Climate Change and Management of Protected Natural Areas PN: 10.9070. 3-001.00).
- Newsham, A., Pulido-Silva, M.T., Muñoz Cruz, R., Ulrichs, M., Camacho Castillo, E., Cantellano Ocón, X., Gonzalez Áviles, B.Y., Shankland, A., 2012b. Análisis de los resultados de la aplicación de herramientas de metodología participativa para el análisis de vulnerabilidad de estrategias de vida (AVEV) al cambio climático: Comunidad de Laguna de Mante, Ciudad Valles San Luis Potosí. Institute of Development Studies, Universidad Autónoma del Estado de Hidalgo, Universidad Iberoamericana de Puebla, GIZ, Brighton (Report submitted for GIZ-CONANP 'Project Climate Change and Management of Protected Natural Areas PN: 10.9070. 3-001.00).
- O'Brien, K., 2012. Global environmental change II from adaptation to deliberate transformation. *Prog. Hum. Geogr.* 36 (5), 667–676.
- Olsson, P., Folke, C., Berkes, F., 2004. Adaptive comanagement for building resilience in social-ecological systems. *Environ. Manag.* 34, 75–90.
- Pelling, M., 2011. *Adaptation to Climate Change: From Resilience to Transformation*. Routledge, London, New York.
- Petersen, C., Holness, S., 2011. *South Africa: Ecosystem-Based Planning for Climate Change* [Online]. World Resources, Washington D.C. World Resources Report, Available from: <http://www.cakex.org/virtual-library/south-africa-ecosystem-based-planning-climate-change> (Accessed 14 Oct 2013).
- Potter, J.F., 1997. Sustainable development: are we being conned? *Environmentalist* 17, 147–148.

- Pramova, E., Locatelli, B., Djoudi, H., Somorin, O.A., 2012. Forests and trees for social adaptation to climate variability and change. *Wiley Interdiscip. Rev. Clim. Change* 3 (6), 581–596.
- Quintero, M., Newsham, A., Muñoz, R., Cannon, T., Tapasco, J., Peña del Valle, A.E., Ortiz Espejel, B., 2012. Marco Conceptual para el análisis multi-escalar de vulnerabilidad al cambio climático de ecosistemas terrestres prioritarios y estrategias de vida de la población rural en la zona cen-tral de la Sierra Madre Oriental. Institute of Development Studies, Centro Internacional de Agricultura Tropical, Universidad Iberoamericana Puebla, Programa de Investigación en Cambio Climático, Universidad Nacional Autónoma de México, México D.F (Report submitted for GIZ-CONANP 'Project Climate Change and Management of Protected Natural Areas PN: 10.9070.3-001.00).
- Redclift, M., 2005. Sustainable development (1987–2005): an oxymoron comes of age. *Sustain. Dev.* 13, 212–227.
- Reid, H., 2011. Improving the Evidence for Ecosystem-based Adaptation [Online]. IIED, London. Available from: <http://pubs.iied.org/pdfs/17109IIED.pdf> (Accessed 19 November, 2015).
- Reid, H., 2014. Ecosystem-and Community-Based Adaptation: Learning from Natural Resource Management [Online]. IIED, IIED Briefing, London. Available from: <http://pubs.iied.org/pdfs/17243IIED.pdf> (Accessed 19 November, 2015).
- Robbins, P., 2012. Political Ecology: A Critical Introduction. John Wiley & Sons.
- Roe, D., 2008. The origins and evolution of the conservation-poverty debate: a review of key literature, events and policy processes. *Oryx* 42 (4), 491–503.
- Ruiz-Mallén, I., Corbera, E., Calvo-Boyero, D., Reyes-García, V., Brown, K., 2015. How do biosphere reserves influence local vulnerability and adaptation. Evidence from Latin America. *Glob. Environ. Change Hum. Policy Dimens.* 33, 97–108.
- Salafsky, N., 2011. Integrating development with conservation A means to a conservation end, or a mean end to conservation? *Biological Conservation* 144, 973–978.
- SCBD, 2009. Biodiversity and climate-change adaptation. Technical series. Connecting Biodiversity and Climate Change Mitigation and Adaptation: Report of the Second Ad Hoc Technical Expert Group on Biodiversity and Climate Change. Montreal [Online]. Secretariat of the Convention on Biological Diversity, Montreal, pp. 126. Available from: <https://www.cbd.int/doc/publications/cbd-ts-41-en.pdf> (Accessed 19 November, 2015).
- SEDESOL (Secretaría de Desarrollo Social), 2013a. Catalogo de Localidades, Sistema de Apoyo para la planeación del PDZP. Available from: <http://www.microrregiones.gob.mx/catloc/LocdeMun.aspx?tipo=clave&campo=loc&ent=24&mun=054> (Accessed 02 February, 2017).
- SEDESOL (Secretaría de Desarrollo Social), 2013b. Catalogo de Localidades, Sistema de Apoyo para la planeación del PDZP. Available from: <http://www.microrregiones.gob.mx/catloc/LocdeMun.aspx?tipo=clave&campo=loc&ent=24&mun=013> (Accessed 02 February, 2017).
- Sklair, L., 2001. The Transnational Capitalist Class. Wiley.
- Sullivan, S., 2006. Elephant in the room? Problematising 'New' (Neoliberal) biodiversity conservation. *Forum Dev. Stud.* 33 (1), 105–135.
- TEEB, 2010. The Economics of Ecosystems and Biodiversity: Mainstreaming the Economics of Nature: A synthesis of the Approach, Conclusions and Recommendations of TEEB [Online]. The Economics of Ecosystems and Biodiversity. Available from: <http://www.teebweb.org/wp-content/uploads/Study%20and%20Reports/Reports/Synthesis%20report/TEEB%20Synthesis%20Report%202010.pdf> (Accessed 16 October, 2013).
- Taylor, M., 2014. The Political Ecology of Climate Change Adaptation: Livelihoods, Agrarian Change and the Conflicts of Development. Routledge.
- UNEP, 2012. Making the Case for Ecosystem-Based Adaptation: Building Resilience to Climate Change [Online]. UNEP, UNDP, IUCN, Nairobi. Available from: <http://ebaflagship.org/resources/publications/reports/335-eba-policy-brief> (Accessed 14 October, 2013).
- Ulrichs, M., Newsham, A., Shankland, A., Cannon, T., 2013. Guión Metodológico para el Análisis de Vulnerabilidad Social y Capacidad de Adaptación al Cambio Climático a Nivel de Comunidad Rural. Institute of Development Studies, GIZ, Comisión Nacional de Áreas Naturales Protegidas (CONANP), Brighton.
- Wells, M., Brandon, K., Hanna, L., 1992. People and Parks: Linking Protected Area Management with Local Communities.
- Wells, M., Guggenheim, S., Khan, A., Wardoyo, W., Jepson, P., 1999. Investing in Biodiversity: A Review of Indonesia's Conservation and Development Projects.
- Wertz-Kanounnikoff, S., Locatelli, B., Wunder, S., Brockhaus, M., 2011. Ecosystem-based adaptation to climate change: what scope for payments for environmental services? *Clim. Dev.* 3 (2). [online] Available from: <https://www.cifor.org/library/3462/ecosystem-based-adaptation-to-climate-change-what-scope-for-payments-for-environmental-services/> (Accessed 19 December, 2017).
- World Bank, 2009. Convenient Solutions for an Inconvenient Truth [Online]. The World Bank. Available from: <https://doi.org/10.1596/978-0-8213-8126-7> (Accessed 19 November, 2015).
- van de Sand, I., Mwangi, J.K., Namirembe, S., 2014. Can payments for ecosystem services contribute to adaptation to climate change? Insights from a watershed in Kenya. *Ecol. Soc.* 19 (1), 47.